

The Builder.

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IN a maritime country like England, the construction of LIGHT-HOUSES is a subject of great importance, and it becomes of the utmost consequence that the details of such works should be carefully recorded, including the relation of failures as well as successes, and when completed, that they should be made public to the utmost possible extent. So, indeed, it should be with all great works of the architect and engineer,—important buildings, public and private, railways, bridges, docks, &c.,—so as to facilitate to the utmost the progress towards perfection. The disinclination towards this publication on the part of contemporaries, of architects even more than of engineers, is much to be regretted, and in many cases reprobated. Such books, it is true, are costly, and the certainty of a return not always clear; but it is not this which usually weighs, as has been proved again and again. Still we would have even the pretext removed in the case of really important works, by the certainty of receiving such aid from public bodies as would lessen the risk and encourage the attempt. What is for national service might justly expect to receive national aid. The requirement of a number of copies for certain public libraries is a heavy and most unjust tax on the producers of costly books, and ought to have been abolished long ago,—the books being of course still deposited, but paid for out of funds provided for that purpose.

Regarding the publication of simple details of structural works as of this great importance, then, and regretting that they are seldom given to us, our praises are eminently due to those who, not afraid of "making others as wise as themselves," or of affording grounds for criticism, furnish information of this character. Amongst these we will place Mr. Alan Stevenson, whose "Account of the Skerryvore Lighthouse; with Notes on the Illumination of Lighthouses," has been before us for some little time, and has afforded us much gratification and instruction.* Before endeavouring to give our readers a general notion of the contents of this volume,—a large quarto, containing 440 pages and 33 plates,—let us remark, that in our last volume will be found a valuable account of the construction of the lighthouse recently erected at the port of Havana,† and in the present volume a brief notice of the history of lighthouses. Their early history is very obscure, though allusions to the subject of beacon-lights are to be found in many ancient writings. The celebrated Colossus of Rhodes, constructed about 300 years before our era, was probably a lighthouse. The Pharos of Alexandria, built about the same time, was regarded as one of the wonders of the ancient world. Strabo, who describes it, gives the impression that it must have been of immense size: he says *Sostratus* was the architect, and *Phiny* states that it cost

a sum equal to either 390,000*l.* of our money, or 194,000*l.*, probably the former, but depending upon whether he was speaking of the Egyptian talent or the Attic talent. Mr. Stevenson gives some curious particulars of this structure. Lucian, in his art of writing history, accuses Sostratus of a fraud, in cutting his own name on the solid wall of the tower, and covering the inscription with plaster on which he carved the name of his royal master, Ptolemy. *Phiny*, on the contrary, expressly states, as a proof of Ptolemy's magnanimity, that he gave the architect liberty to inscribe his own name. Enough, however, of this, simply adding the note, that the Latin words *turris* and *columna* have been supposed, primarily, to signify a lighthouse, the first being written *torris*, the tower of fire; and the *col-um*, the pillar of the sun!

The most important lighthouse, in point of architectural splendour, is the *Tour de Cordouan*, on the coast of France, commenced in 1584, but not finished till 1610. *Belidor* describes it fully in the "Architecture Hydraulique." It stands upon a solid mass of masonry, consists of four stories 169 feet high, and displays pilasters, entablatures, pinnacles, dormers, and a stone dome. The lowest story is Doric, the second Ionic, the third Corinthian, and the lantern Composite. Some of the interior apartments are very fine, and exhibit paintings and mosaics.*

Our famous Eddystone Lighthouse is well known from Smeaton's own valuable and interesting narrative,† as is also the second in importance, the Bell Rock Lighthouse, from the account of its architect, Mr. Robert Stevenson, father of the gentleman whose work is before us, and to which we now again turn.

Neither of these which we have last-named are so lofty as the Skerryvore Tower, which we should say is situated near the island of Tyree and the island of Iona.

The first stone was formally laid on the 7th of July, 1840, and the last in August, 1842, although the operations were commenced in 1838, and the men were on the rock six seasons. Only those who know the difficulties and dangers of such works will sufficiently appreciate the fact that, during the whole of that time, there was no loss of either life or limb. "Those who best know the nature of the service in which we were engaged," says our author, "the daily jeopardy connected with landing weighty materials in a heavy surf and transporting the workmen in boats through a boisterous sea, the risks to so many men, involved in mining the foundations of the Tower in a space so limited, and above all, the destruction, in a single night, by the violence of the waves, of our temporary barrack on the rock, which had cost the toils of a whole season, will not wonder that I am anxious to express,—what I know to have been a general feeling amongst those engaged in the work, that of—heartfelt thankfulness to Almighty God for merciful preservation in danger, and for the final success which terminated our arduous and protracted labours."

The barrack which they first erected on the rock, for the protection of the workmen, was washed away, as above noted, in a night; but, with this exception, they appear to have gone on from the commencement to the end, steadily preparing for any coming difficulties, and always successfully meeting them.

The third chapter of the work treats of the

construction of lighthouse towers generally, and involves two considerations:—1. Those which refer to elements common to light-houses in all situations, and differ only in amount,—such as the height of the tower necessary for commanding a given visible horizon, and the accommodation required for keepers and stores; and, 2nd, those which are peculiar to towers in exposed situations, and refer solely to their fitness to resist the force of the waves, which tend to destroy them. Under the second head our author remarks, that we know little of the nature, amount, and modification of the forces, on the proper investigation of which the application of the principle which regulates the construction must be based. There have been few experiments to measure the force of the waves: we cannot be said to possess the elements of exact investigation, and must, consequently, be guided chiefly by "the result of those numerous cases which observation collects and which reason arranges, in the form which constitutes what is called professional experience." Our author remarks:—

"We must not, however, in any case, venture to approach too near the limit of stability, so long as we continue to labour under our present disadvantages of defective information on some of the most important elements in the inquiry. If it be asked, therefore, how the size and form of buildings exposed to the shock of the waves are to be determined, the answer must be, that, in any given case, the problem is to be solved chiefly by the union of an extensive knowledge of what the sea has done against man, and how, and to what extent, man has succeeded in controlling the sea; together with a cautious comparison of the circumstances which modify and affect any given case which has not been the object of direct experience; nor does it seem possible as yet to found the art of engineering, in so far as it refers to this class of works, upon any more exact basis. The uncertainty which must ever attend such reasoning can only, it is obvious, be dispelled by actual experience of the result; and time only can test the success of our schemes in cases of difficulty."

A primary inquiry, in regard to towers in an exposed situation, is the question, whether their stability should depend upon their strength or their weight; or, in other words, on their cohesion, or their inertia? In preferring weight to strength, we more closely follow the course pointed out by the analogy of nature; and this must not be regarded as a mere notional advantage, for the more close the analogy between nature and our works, the less difficulty we shall experience in passing from nature to art, and the more directly will our observations on natural phenomena bear upon the artificial product."

In respect of form, he says:—

"The sum of our knowledge appears to be contained in this proposition—That, as the stability of a sea-tower depends, *ceteris paribus*, on the lowness of its centre of gravity, the general notion of its form is that of a cone; but that, as the forces to which its several horizontal sections are opposed decrease towards its top in a rapid ratio, the solid should be generated by the revolution of some curve line convex to the axis of the tower, and gradually approaching to parallelism with it. And this is, in fact, a general description of the Eddystone Tower devised by Smeaton."

Our author's inquiry into the best form to be adopted is interesting, but we have not space to follow him in it: suffice it to say, that the outline of the Skerryvore column is generated by the revolution of a rectangular hyperbola about its asymptote as a vertical axis. The whole height is 138½ feet; its diameter, at the base, 42 feet; and at the top 16 feet.

"The first 26 feet of height is a solid frustum, containing about 27,110 cubic feet, and weighing about 1,990 tons.* Immediately

* Account of the Skerryvore Lighthouse; with Notes on the Illumination of Lighthouses. By Alan Stevenson, LL.B., &c. By order of the Commissioners of Northern Lighthouses. Adam Black and Co., Edinburgh; Longman and Co., London. 1848.

† See Vol. V., p. 257.

‡ See p. 28, ante.

* Mr. Grey, in his "Encyclopedia of Civil Engineering," gives some particulars, and several engraved illustrations, of this structure.

† Condensed by Grey, in his "Encyclopedia."

* At the rate of 13.62 cubic feet of granite to a ton.